Wisconsin DNR Forest Health 2014 Annual Report

Giant swallowtail caterpillar. Photo by Bernie Williams.

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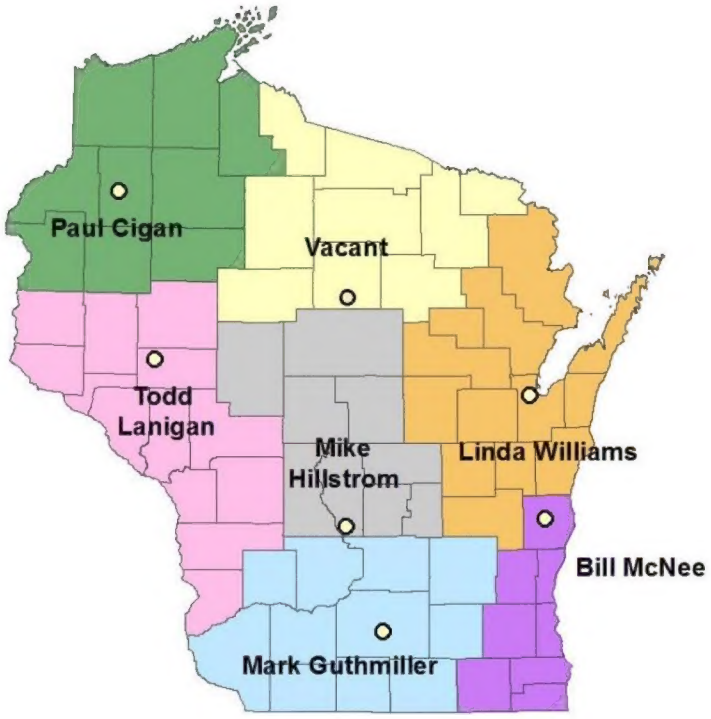
Wisconsin DNR Forest Health Staff

(as of December 31, 2014)



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Forest Resources in Wisconsin

Wisconsin's forests are critical for providing wildlife habitat, clean air and water, reducing erosion, and improving the quality of life in urban and rural areas. Forests are also important to the economy of Wisconsin for wood products, recreation and tourism. The primary and secondary wood products industry is one of the five largest employers in the state and puts Wisconsin first in the nation in the production of fine paper, sanitary paper products, children's furniture and millwork. The annual value of these products is about $20 billion. Forest and water resources in Wisconsin are a primary tourism attraction for both residents and visitors. The variety of Wisconsin's forest ecosystems supports a great diversity of wildlife species, while recreational use of the forests continues to grow and expand.

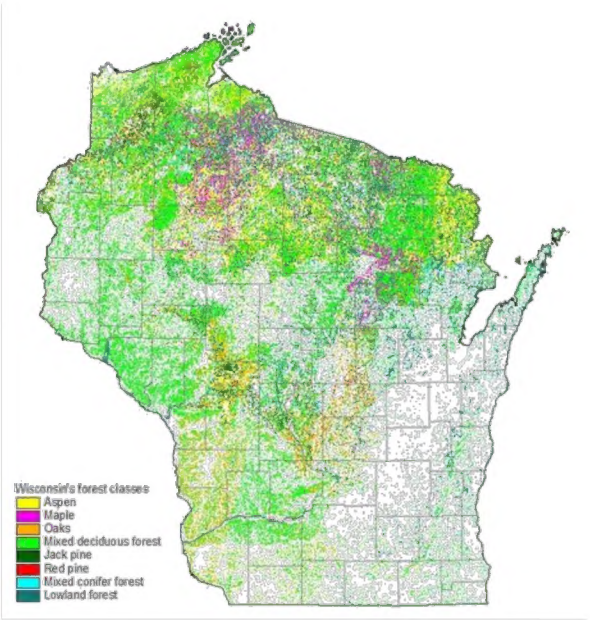

Figure 1. Wisconsin forest cover map.

Area of Forests by Type and Age Class

The area of forest land in Wisconsin has been steadily increasing in recent decades, and currently stands at approximately 16.8 million acres (Figures 1 and 2). This is an increase of almost 2 million acres since 1983 and 1 million acres since 1996. Most of this increase has been in central and southeast Wisconsin. Wisconsin now has more forested land than at any time since the first forest inventory in 1936, and over 46% of Wisconsin's land area is forested.

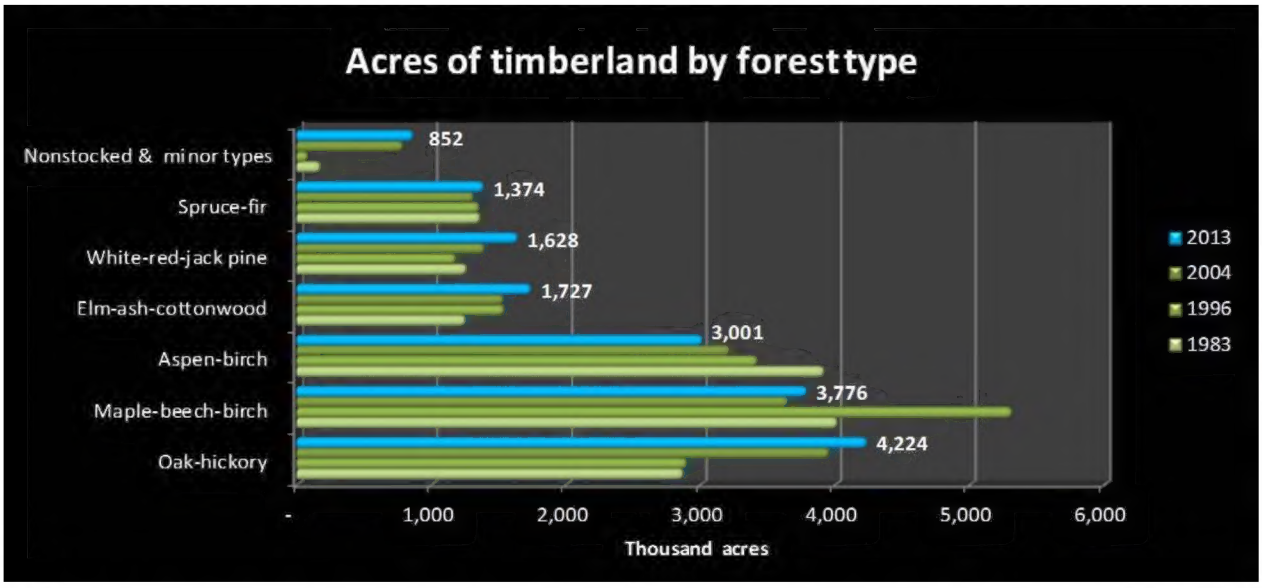

Figure 2. Wisconsin timberland area by forest type (FIA data, US Forest Service).

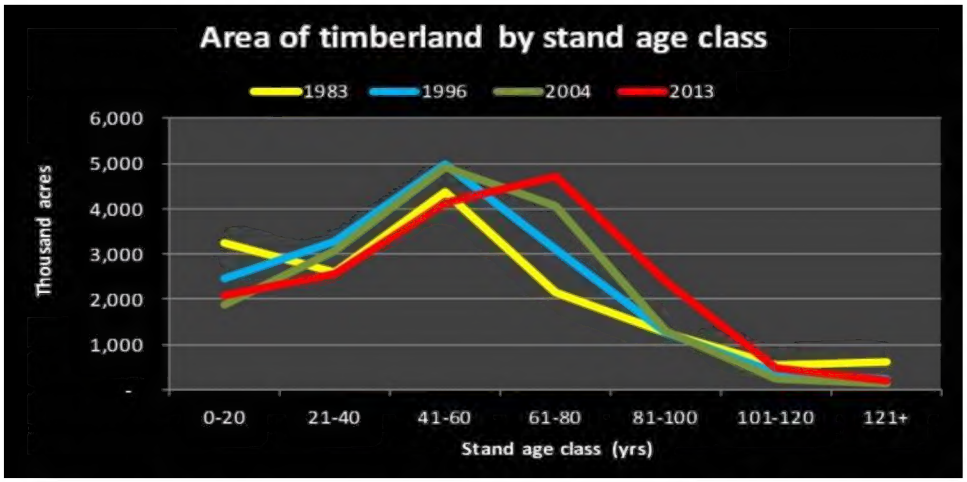

Figure 3. Timberland acreage by stand age class (FIA data, US Forest Service).

Wisconsin's forests are predominantly hardwoods, with about two-thirds of all timberland in the maple-beech-birch, oak-hickory or aspen-birch forest types. The primary hardwood forest types are oak-hickory at 25% of total forested acreage, maple-beech-birch at 23% and aspen-birch at 18%. Conifer types, mainly pine and spruce-fir, represent about 18% of the timberland. Wisconsin's forests are becoming middle-aged, with less acreage in young and old stands and a sharp increase in stands 60 to 100 years old (Figure 3). In 1983, 22% of stand acreage was less than 20 years old. In 2013, this had decreased to only 13%.

Volume and Trends in Major Species

As of 2013, there is an estimated 21.4 billion cubic feet of wood in Wisconsin's forests (Figure 4). The greatest volume of any major species in 2013 is in soft maples (red and silver maple), where volume has nearly doubled since 1983. The second highest volume is in sugar maple, where volume has increased by nearly 60% since 1983. Aspen ranks third by volume but its total has decreased 13% over the last 30 years. Northern red oak ranks fourth, but its volume has decreased by 10% since 1983.

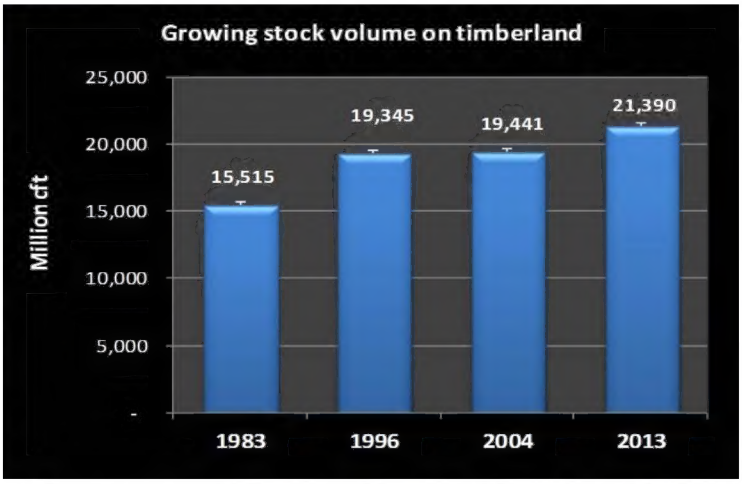

Figure 4. Volume of growing stock (FIA data, US Forest Service).

The greatest percentage volume gains in the last three decades have been in black walnut (up 423%), white pine (up 192%) and red pine (up 118%). The greatest percentage volume losses in the last three decades have been in jack pine (down 58%), paper birch (down 51%) and

balsam fir (down 26%). These changes are due to a combination of natural succession and harvest losses that have not been replaced.

Exotic Species Issues

Annosum Root Rot

Annosum root rot, caused by the fungus, *Heterobasidion irregulare*, was first found in Wisconsin in 1993 and is now known to be present in 24 counties (Fig. 5). It is considered to be one of the most destructive conifer diseases in the northern hemisphere. Prevention of this disease is key, as it is difficult to treat and control. Many tree species can be hosts, but in Wisconsin, annosum root rot is most common in red and white pine plantations.

Figure 5. Counties where annosum root rot has been detected.

Although there were no new county detections in 2014, additional infections were found in counties where the disease was previously documented. The River Valley School Forest in Iowa County, where annosum was detected in the early 1990s, was re-surveyed to evaluate disease spread. Numerous newly-infected disease pockets were found. An intensive survey was also conducted at a 2013 detection site in Grant County on the Blue River Unit of the Lower Wisconsin State Riverway, and additional disease pockets were detected.

Beech Bark Disease

Beech scale detection sites in northeast and southeast Wisconsin, where the presence of beech scale had previously been lab-confirmed, were revisited in summer 2014 to evaluate changes in beech scale populations. Sites were located in Manitowoc, Marinette, Ozaukee, Sheboygan and Washington Counties. It was found that scale populations had remained very low since being detected in 2010-11, and there were no signs of tree decline or mortality associated with beech bark disease. In the southeast, the highest observed scale populations consisted of a few visible pieces of scale 'wool' per tree at Highland Woods in Mequon (Ozaukee County). Three Dodge County sites were also visited, and no signs of beech scale were seen (one of the sites had a previous visual report of beech scale that was not lab-confirmed).

To date, beech bark disease and tree mortality have only been observed in Door County. Pockets of high scale populations, beech bark disease and tree mortality have continued to expand in size. High scale populations have now been found in several areas of Door County, including on Washington Island and Rock Island. At Whitefish Dunes State Park in eastern Door County, beech trees within 75 feet of hiking trails were removed (Figure 6) to mitigate the

safety hazard that infected trees create when the trees 'snap' in high winds. In addition, beech trees in the road right-of-way were removed by the local government shortly before the timber harvest at the park.

Figure 6. A timber sale to remove hazard beech trees was conducted at Whitefish Dunes State Park in April 2014.

Chestnut Blight Study

(Prepared by Mark Double and William MacDonald, West Virginia University)

An 89 acre hillside in West Salem (La Crosse County) was permanently altered when American chestnut seed was planted there in the late 1880s. Chestnut trees flourished, and by the early 1990s more than 3,000 stems could be identified. They now range in size from less than 1 inch to more than 60 inches in diameter. The stand, currently considered the largest American chestnut stand in North America, is 375 miles west of the natural range. The site was free of chestnut blight until 1987, when cankers were observed on four trees. The discovery of blight presented an opportunity for researchers from Cornell University, Michigan State University, West Virginia University, University of Wisconsin - La Crosse and the Wisconsin Department of Natural Resources to initiate collaborative studies in 1992 using a biological approach to control the disease.

Figure 7. Treatment of a chestnut blight canker with virus-containing inoculum.

The fungus that causes chestnut blight, *Cryphonectria parasitica*, can become infected with a virus that debilitates it (known as a 'hypovirus'). Virus-containing fungal strains grow more slowly than the normal strains, allowing the tree's defenses to combat the disease. In an effort to initiate biological control, virus-infected strains of the fungus have periodically been introduced into small punch wounds around the margin of cankers (Figure 7).

Since 1992, researchers have identified 3,405 cankers (Figure 8) and many of them have been treated with the virus-containing strain of the fungus. Because spread of the virus-infected strains cannot be detected visually, the only way to evaluate virus spread is to remove small bark samples from each canker, isolate the fungus, and determine whether it has acquired the virus. Normal fungal cultures can be distinguished from the debilitated forms by their color and appearance on agar media.

A general summary of findings is:

- Trees have continued to die, although they have produced abundant sprouts.
- The hypovirus has spread on trees that contain treated cankers.
- 24% of the main stems that were treated with virus-infected strains remain alive, with callousing infections. Crown health is improving. 9% of untreated trees remain alive.

Summary of 2014 findings:

- Movement of the hypovirus to untreated trees has increased in all areas of the stand.
- Sixty cankers were newly discovered in 2014.
- Virus treatment appears to play a role in tree longevity. Main stem survival in the area where the disease was first discovered is 23%. In the more recently-infected areas, tree survival is 8%.

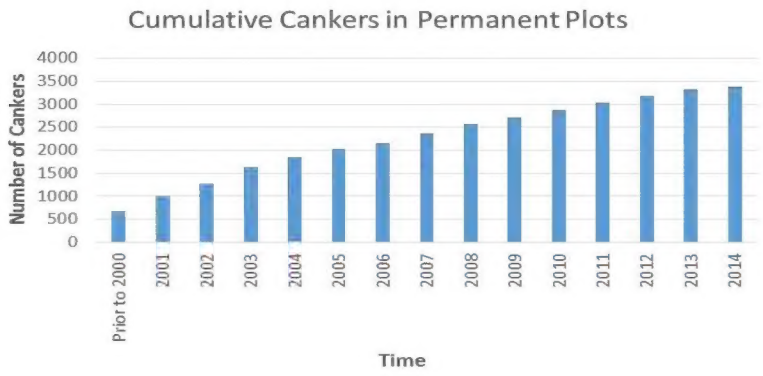

Figure 8. Cumulative number of chestnut blight cankers at the West Salem study site.

Earthworms and Crazy Worm, *Amynthas* spp.

In 2014, public awareness of invasive earthworms continued to grow. Non-native European earthworms arrived with the first settlers and have been widely dispersed through soil disturbance, land management, fishing bait, gardening, etc. Wisconsin does not have native earthworms, and 21 European species have been found. Earthworms have been touted as nature's recyclers, though when introduced to a landscape where they are not native, they become highly invasive species that change their environment to suit their survival. In addition, they often increase the spread of non-native invasive plants as well as native aggressive species by changing the soil biota.

The long-term effects that European earthworms will have on forests are still unknown. It is known that certain hardwood species, such as sugar maple, may have diminished seedling survival and regeneration at sites where earthworms are present, and the trees can show signs of stress when worms are present in the understory. It is important to note that tree

regeneration is also influenced by other factors such as invasive plants, drought and deer herbivory.

Crazy worm, *Amynthas* spp.

Wisconsin's first detection of crazy worm (*Amynthas* spp., Figure 9) occurred in Madison in October 2013. When crazy worms were listed as a 'Prohibited' species under NR 40 in 2009, it was believed that the species would be unable to survive Wisconsin's winters. This belief turned out to be incorrect and while the adult earthworms are unable to survive, their cocoons persist and hatch in the spring. In the summer of 2014, five counties were found to have multiple infestations and a number of additional, isolated infestations were confirmed from around the state. Because crazy worms are more widespread than initially thought, the DNR is proposing to reclassify them as a 'Restricted' species under NR 40.

Figure 9. Crazy worm specimen found in Madison.

Currently, all known crazy worm infestations are located in urban areas and there are no verified occurrences of crazy worms in forests. Given that this is a new invasive species in Wisconsin, there is expected to be a steep learning curve for control and recommendations. So far, researchers have determined that the life cycle resembles an annual species, reaching maturity in 60 days and reproducing asexually. With such rapid population growth, they can reach infestation levels by the end of a growing season. Anecdotal evidence indicates they may have detrimental effects on the soil community and disrupt the regeneration of native species.

DNR staff are currently developing reasonable precautions to control the species and minimize their spread. Population management studies will be conducted in 2015 to determine how crazy worm populations react to fire and fertilizers. DNR will be collaborating with a number of universities and researchers on how to best assess and control the spread of crazy worms.

Emerald Ash Borer

In 2014, DNR staff worked with private landowners, communities and public land managers to detect emerald ash borer (EAB, Figure 10) infestations, manage current infestations, and prepare forests so that future impacts of the insect are reduced. Reducing EAB impacts can be accomplished through timber harvests, urban tree removals, insecticide treatment of high-value ash, and encouraging the growth of non-ash species.

Figure 10. EAB adult.

Aerial and ground surveys conducted in 2014 found that EAB impacts continued to increase in both rural and urban forests. Dramatic increases in tree mortality were observed at many sites (Figure 11), due to a rapid buildup of EAB populations aided by the 2012 summer drought. The thinning canopies of infested ash trees could be seen at many locations, most notably in southeast Wisconsin.

Figure 11. Extensive ash mortality near Newburg (Ozaukee and Washingon Counties).

In 2014, EAB life stages were found in ten additional Counties: Adams, Buffalo, Calumet, Columbia, Door, Grant, Jefferson, Monroe, Oneida and Sheboygan. Twenty eight of Wisconsin's 72 counties have known infestations (Figure 12). The pest was detected at several DNR properties in 2014 – at Nelson Dewey State Park in Grant County, Avon Bottoms State Wildlife Area in Rock County, Merrick State Park in Buffalo County, Kettle Moraine State Forest – Pike Lake and Southern Units – in Walworth, Washington and Waukesha Counties, Princes Point State Wildlife Area in Jefferson County, Silver Lake Marsh Fishery Area in Kenosha County and Rush Creek Natural Area in Crawford County.

The current year saw a continued increase in the number of communities where EAB has been detected. New 2014 municipal detections (Village or City) were:

- Calumet Co. – Sherwood
- Dane Co. – Middleton
- Door Co. – Sturgeon Bay
- Jefferson Co. – Fort Atkinson
- Kenosha Co. – Paddock Lake, Silver Lake
- Milwaukee Co. – St. Francis
- Monroe Co. – Oakdale, Wyeville
- Oneida Co. – Rhinelander
- Ozaukee Co. – Belgium, Cedarburg, Grafton, Mequon
- Sheboygan Co. – Random Lake
- Trempealeau Co. – Arcadia
- Walworth Co. – Bloomfield
- Washington Co. – Hartford, Jackson, Slinger
- Waukesha Co. – Muskego

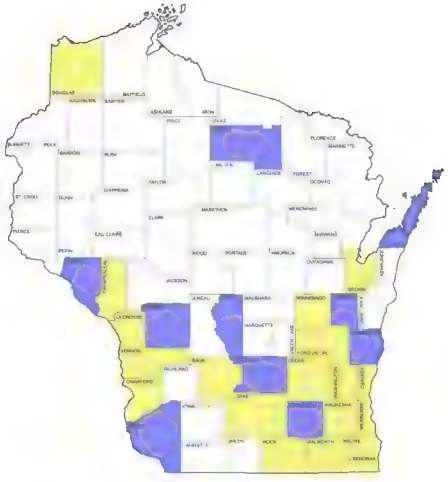

Figure 12. Counties with first EAB detections in 2014 are shown in blue. Counties in yellow had first detections in earlier years.

Seventeen counties were added to the state EAB quarantine area in 2014 although EAB has not been found in all 17. Thirty seven counties are now included in the EAB quarantine area (Figure 13).

Figure 13. Counties quarantined for emerald ash borer as of December 2014 are shown in red.

The DNR Forest Health program prepared 45 double-decker EAB detection traps at 30 state properties in 2014. This trap has been shown to be effective at finding low populations of EAB. This trapping effort was successful, as the pest was detected on these traps at Merrick State Park in Buffalo County and Kettle Moraine State Forest – Southern Unit in Walworth and Waukesha Counties.

Tiny, stingless wasps from Asia (Figure 14) have been released in select infested areas since 2011 to act as parasitoids of EAB life stages and help reduce emerald ash borer populations. *Tetrastichus planipennisi* attacks EAB larvae and *Oobius agrili* attacks EAB eggs on the bark surface. In 2014, approximately 5,800 *T. planipennisi* and 1,100 *O. agrili* were released at three sites in Milwaukee, Ozaukee and Washington Counties. The parasitoids were supplied by the USDA EAB Parasitoid Rearing Facility in Brighton, Michigan.

Figure 14. *Tetrastichus planipennisi*, a stingless wasp that attacks EAB larvae beneath the bark. Actual size is ¼".

Firewood Regulation

In response to the increasing risks of introducing emerald ash borer and other wood-borne pests and diseases, the DNR reduced the distance from which firewood must originate in order to be brought into a state property. In June 2014 this distance was reduced to 10 miles from the previous 25 mile limit. Firewood that may enter DNR-owned property has been regulated since 2006, when out of state wood was first prohibited. In 2007, wood originating more than 50 miles from the destination property was added to the prohibition. In 2010, this allowable distance was decreased to 25 miles. Wood certified as being treated to kill infesting organisms has always been allowed in regardless of origin.

The 10 mile limit was chosen for several reasons. The first is that if an invasive species is present within 10 miles of a property, it is likely to make its way there on its own within a few years. Second, allowing wood from short distances helps to increase compliance with the rule by reducing the perception of a firewood monopoly at state campgrounds. A 10 mile limit also provides an alternative source of wood at the property when the campground vendor is closed.

Gypsy Moth

Total recorded defoliation in 2014 was only 85 acres, down from 12,248 acres defoliated in 2013. Moderate defoliation was observed in an 80 acre stand of young aspen in northwest Ashland County, and 5 acres of a young oak plantation were heavily defoliated in Jefferson County. Elsewhere, a handful of defoliated ornamental trees were reported from Clark, Fond du Lac, Marathon, Portage, Rock and Winnebago Counties. There were very few reports of nuisance caterpillars (Figure 15) in 2014. High numbers of egg masses were only reported from the Town of Beloit in Rock County and the City of Oshkosh in Winnebago County. In 2014, the national Slow-The-Spread Program reported high adult moth catches in eastern Bayfield County and northern Ashland County. These two counties will be monitored by DNR forest health staff in 2015.

Figure 15. Gypsy moth caterpillar.

For the third consecutive year, the DNR gypsy moth suppression program treated only one site. A 29 acre site in Rock County, in the unincorporated community of Afton, was sprayed on May 22. The treatment used Foray 48B at ¾ gallon per acre (36 CLU per acre) and was done by Al's Aerial Spraying of Ovid, Michigan. Spray cost was $39.93 per acre. The treatment area was successfully protected and no reports of nuisance caterpillars were received. This single spray block was cost shared by the USDA Forest Service.

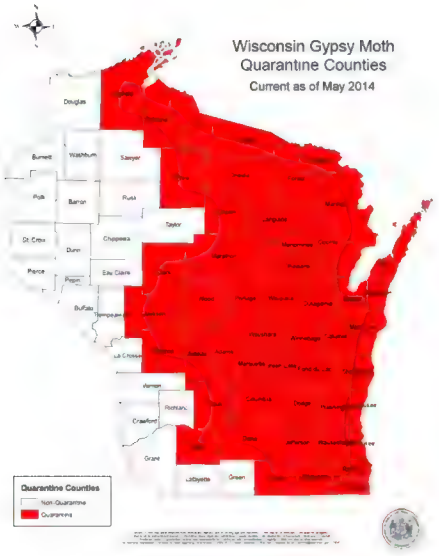

Figure 16. Counties quarantined for gypsy moth. Map by the Wisconsin Department of Agriculture, Trade and Consumer Protection.

Effective March 31, 2014, Iowa County became a regulated county for gypsy moth. With this addition, 49 of Wisconsin's 72 counties are now within the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) quarantine for gypsy moth (Figure 16).

Invasive Plants

Wisconsin DNR continues to be at the forefront of addressing the spread of invasive plants across Wisconsin's landscape, through the adoption of Administrative Rule NR 40 in 2009, the implementation of Best Management Practices (BMPs), and the Early Detection and Rapid Response reporting system. In addition, by partnering with University of Wisconsin Extension, Cooperative Weed Management Associations and the forest industry, DNR continues to map and control invasive plants that are listed as 'Prohibited' or 'Restricted' under NR 40.

Invasive Species Rule NR 40 is presently going through a rule revision in order to include

several ornamental species that DNR Species Assessment Groups have determined to be a threat. Many are widely-sold cultivars that have been documented as invading and naturalizing in forests and natural areas. One example is Japanese barberry, *Berberis thunbergii,* and 25 cultivars (Figure 17). It is being found in both upland and lowland forests, and its presence is affecting native species through reduced regeneration and declines in native biodiversity. The spread and propagation of barberry has also been shown to encourage the spread of deer ticks (*Ixodes scapularis*), as large thickets of Japanese barberry essentially encourage "tick nurseries" and the possible spread of tick-borne diseases.

Figure 17. Japanese barberry in a pine plantation.

Invasive Species Rule NR 40

Wisconsin's Invasive Species Rule (Wisconsin Administrative Code, Chapter NR 40) is currently being revised to include additional species. The changes will include delisting 2 species, changing the regulated status of 4 species, listing 50 new 'Prohibited' species, listing 32 new 'Restricted' species, and listing 2 species as split-listed ('Prohibited' or 'Restricted' depending on location). Proposed revisions will also include changing language to increase clarity and updating species names. Some of the currently-listed species and species proposed for listing have been widely sold even though have been found to be highly invasive, escape cultivation and spread. Proposed revisions and adoption are expected to be in place by September 2015. Continued species assessments and NR 40 revisions will aid the management of non-native species which may become a threat to forests now and in the future.

Oak Wilt

Oak wilt, caused by the pathogen, *Ceratocystis fagacearum*, is a serious fungal disease that is fatal to oaks in the red oak group – northern pin, northern red and black oak (Figure 18). Oak wilt is common in the southern two-thirds of Wisconsin, but is uncommon in northern Wisconsin (Figure 19). However, DNR forest health staff and UW-Extension cooperators have recently identified several new disease centers in northern Wisconsin.

Figure 18. A "bronzing" oak leaf – wilting from the tip and margin – is symptomatic of oak wilt.

In 2014, oak wilt was confirmed for the first time in Washburn County (Spooner Township), where the infection killed three trees at a private residence. The property owner is currently consulting forest health staff to implement a control option.

Washburn County is considering the implementation of oak wilt harvesting restrictions on county lands in accords with the DNR oak harvesting guidelines.

Additional detections were also made in several other northern counties where oak wilt had been previously detected: Polk Co. (Osceola Township), Burnett Co. (Siren and Swiss Townships), Rusk Co. (Washington Township in the Washington Creek Wildlife Area) and Oneida County (Cassian Township).

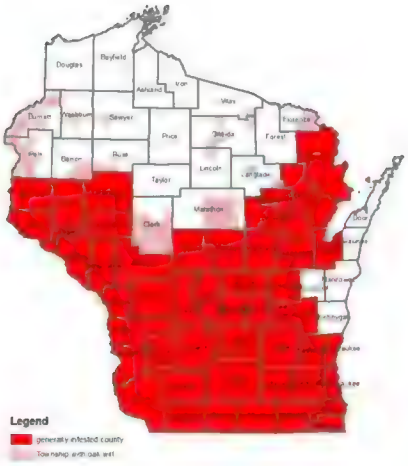

Figure 19. Distribution of oak wilt in Wisconsin. Generally-infected counties are shown in red. Townships where oak wilt is present but uncommon are shown in pink.

In southern and central Wisconsin, a high volume of new oak wilt cases were reported from counties where the disease is relatively common. Concurrent oak wilt infection and two-lined chestnut borer (*Agrilus bilineatus*) infestation was sometimes observed, and it was more frequent than in the past few years. Lab testing to confirm oak wilt was strongly encouraged prior to landowners implementing oak wilt control efforts. In southeast Wisconsin, a notable case of oak wilt was confirmed in an English oak street tree on the south side of Milwaukee. The city is working to contain the infection.

Oak wilt herbicide barrier update

In Wisconsin, herbicides have been used as a potentially effective mechanism to limit the underground spread of oak wilt in stands where physical root severing by a vibratory plow is not a viable option. In this method, trees within grafting distance (identified through Johann Bruhn's model) are treated with Garlon 4 (active ingredient: triclopyr) prior to harvesting. Currently, four stands treated with this method are being monitored annually by DNR and county forestry staff to determine if it is effective.

- At the Nine-Mile Recreation Area in Marathon County, a trial to create a barrier between infected and uninfected trees was initiated in 2003 (details can be found in the 2003 DNR Forest Health Annual Report). Since then, several new oak wilt pockets have been found and treated with herbicide. As of late 2014, no symptomatic trees have been found within grafting distance of any of the pockets that were treated.

- A treatment was implemented on a private property in Dane County in 2006. One large red oak that was approximately 500 feet away from the original pocket was confirmed with oak wilt in 2007, and this second pocket was treated with herbicide in the summer of 2008. No symptomatic trees were found adjacent to these treated pockets in 2014. A new pocket that was found in 2013 was treated with herbicide in 2014 along with a pocket that was found in 2014.

- In 2013, herbicide treatment was performed at two oak wilt pockets on a private property

in Iowa County. Although no symptomatic trees were found near the perimeter of these treated pockets in 2014, three new pockets were found in the stand. These pockets were also treated with herbicide in 2014.

- In 2014, two pockets were treated by a private landowner in Richland County. The stand will be monitored annually by forest health staff.

Oak harvesting timeline deviations

The current Wisconsin DNR oak wilt management guidelines say that to minimize the risk of introduction of oak wilt to a stand, forest managers should not cut oaks or conduct activities that may wound oaks between April 1 and July 15 in the southern counties, and between April 15 and July 15 in the northern counties. It is possible to vary from the guidelines when the landowner/property manager and other affected parties (foresters, loggers, etc.) all agree based on local information. Varying from the guidelines was done for two reasons during 2014:

1) In Juneau County, an exemption to the guidelines was granted because a stand was being managed for maple and other non-oak species. It is not necessary to follow the guidelines if converting to a non-oak type or if oak is not an important part of the stand's future.

2) In a number of cases, the winter cutting period in oak stands was extended due to a late spring. Winter conditions were still present in many areas when the oak wilt restriction dates arrived, and the Nitidulid beetles that vector the oak wilt fungus had not emerged.

   The rule of thumb (from University of Minnesota Extension) is that Nitidulid beetles will start flying in the spring after four or five sunny days with little wind and 55 to 60 degree temperatures. An additional rule of thumb, provided by Dr. Jennifer Juzwik (US Forest Service), is that a stand would be at risk in an early spring if temperatures were above 60 degrees for 7 consecutive days. It is not certain if the same can be applied for evaluating risk in mid-to-late April.

Walnut Twig Beetle and Thousand Cankers Survey

In 2014, the DNR Forest Health program continued monitoring for walnut twig beetle and thousand cankers disease in southern and west central Wisconsin. Walnut twig beetle is a tiny beetle native to the southwest US, and is the main vector of thousand cankers disease. A total of 45 traps (Figure 20) were placed in 15 counties in southern and west central Wisconsin. No suspicious beetles have been identified as of December 2014. Fungal cultures taken to test for the presence of *Geosmithia morbida,* the fungus associated with thousand cankers disease, have all been negative.

Figure 20. Walnut twig beetle trap.

Hardwood Issues

Basswood Defoliation

Defoliation of basswood occurred early in the spring of 2014 due to several causes. Basswood and beech were severely defoliated by Scarab beetles (*Dechelonyx subyittata*, Figure 21) in Forest, Langlade, Oconto and Shawano Counties. In Wood County, the Scarabs defoliated aspen, basswood, birch, maple and oak west of Wisconsin Rapids. Several early spring caterpillar species caused minor basswood defoliation just north of Wisconsin Dells in Adams County. In early summer, defoliation from basswood leafroller (*Pantographa limata*) was observed in Barron, Price, Rusk, Sawyer, Taylor and Washburn Counties.

Figure 21. Scarab beetles (*Dechelonyx subyittata*) defoliating basswood.

The 2012 and 2013 Forest Health Annual Reports mentioned a late season basswood defoliator. In the fall of 2013, microlepidoptera caterpillars were collected from defoliated leaves and a preliminary identification of *Bucculatrix improvisa* was made. Caterpillars were allowed to pupate and moths emerged this spring (Figure 22). The identification of *Bucculatrix impovisa* was confirmed. No significant defoliation from this insect was noted in 2014 on basswood.

Figure 22. *Bucculatrix improvisa*, adult moth and pupal case, next to a millimeter scale.

Cherry Scallop Shell Moth

Populations of cherry scallop shell moth (*Hydria prunivorata*, Figure 23) increased in the west central counties, and both understory and overstory cherry trees were heavily defoliated. Some of the defoliated trees in the west central part of the state produced a second growth of leaves in late summer, which was very unusual. Defoliation of understory trees, and the occasional mature cherry, was also observed in Marinette and Shawano Counties. In the central part of the state there was one small area of heavy defoliation near Nekoosa in Wood County. The area east of Wisconsin Rapids had been heavily defoliated over the past few years, but only very light damage was noted in this area in 2014.

Figure 23. Cherry scallop shell moth caterpillars. Photo from www.forestryimages.org.

Dead Oak Leaves Retained

Dead leaves left over from the 2013 growing season were retained on scattered northern red oaks throughout the 2014 growing season in a number of northern counties (Figure 24). This retention was most noticeable in Forest, Marinette, Oconto, Oneida and Vilas Counties. The dead leaves were first noticed during spring bud break, when these trees appeared to be leafing out poorly and have thin crowns. Many of the retained dead leaves had tattered petioles from being whipped by the winter winds. Tattered petioles held firm as the growing season progressed, with dead leaves remaining on the trees into August.

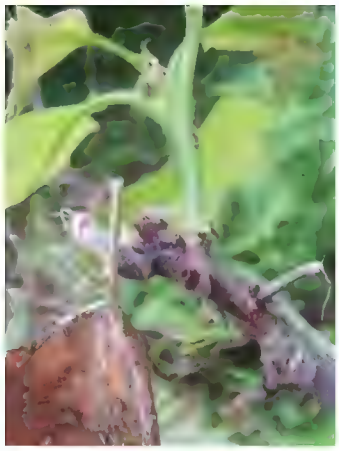

Figure 24. Dead leaves from 2013 remained on some twigs through much of 2014.

The affected northern red oaks were typically saplings, suppressed or intermediate-stage trees. The affected branches usually had a dead terminal bud, or the outer 3-6 inches of the branch tip was dead. A lateral bud or a bud further down the twig had to grow to become the first leaves on the branch. In some cases an adventitious bud had to break from the twig, further delaying leaf emergence for those trees. Winter damage from the long, cold winter of 2013-14 is suspected to have killed the buds and twig tips. Twig samples were collected and cultured, but no fungi were isolated. Later in the season, bur and white oaks in Burnett and Washburn Counties, and northern red oaks in Vilas County, exhibited leaf mortality on scattered branches in the crowns of the trees. Testing of those trees identified Botryosphaeria canker as the pathogen.

Heavy Seed Crop and Poor Crowns

Poor crowns and branch dieback were seen on many hardwood species throughout Wisconsin (Figure 25). Severity ranged from single branches to entire trees. Some of these symptomatic trees did not produce viable buds, or the viable buds were killed by the low 2013-14 winter temperatures. As a result, adventitious buds had to break from twigs in order for leaves to appear on the branch. Scattered trees appeared to have put almost all of their resources into seed production in 2013 or 2014, and had minimal leaf development in 2014.

Figure 25. Poor crown development believed to have resulted from a heavy seed crop.

Heavy seed production on ash and maple in 2014 was noted in Ashland, Barron, Fond du Lac, Forest, Marinette, Oneida, Price, Taylor and Vilas Counties, was widespread in southeast Wisconsin across a variety of habitats, and was scattered in southern Wisconsin. In the west central Wisconsin, the majority of the trees with poor crowns were in urban areas.

Stress is often a cause of heavy seed production. The drought of 2012 may have caused the

stress that prompted a heavy seed crop in 2013-14. Unfortunately, the outlook is grim for those trees that devoted all of their energy to seed production and had nothing left for producing buds for the following year. A similar, stress-related situation was noted in some areas of Oconto, Oneida and Shawano Counties, where the crowns of some black cherry were extremely thin. Reports of heavier than normal flowering may be the cause.

Maple Dieback and Mortality

Aerial surveys detected scattered areas of maple dieback and mortality in the Baraboo Hills of Sauk County (Figure 26). Both red and sugar maples were impacted. Damage was scattered with less than 50% of the trees affected, and was most noticeable on the north-facing slopes. These areas were likely impacted by a recent history of elm spanworm defoliation in 2010 and 2011, and severe drought conditions in 2012.

Figure 26. Red maple dieback and mortality in Sauk County.

Site investigations indicated a close association of Armillaria root rot and the areas of dieback and mortality. In addition, wood-boring beetles and green streaking of sapwood were also observed. Bark splitting and epicormic sprouting on the upper limbs and trunk were commonly observed in advanced cases of dieback. Various fungi have been identified from samples collected at a number of sites, including *Fusarium* spp., *Sphaeropsis* state of *Botryosphaeria* spp., and *Phomopsis* spp. Unidentified species of wood-boring beetles appear to be secondary damage agents. The roles of the fungi and beetles in the observed dieback and mortality are uncertain.

At one site in Marquette County, all understory red maples less than five inches in diameter had died over several acres. Armillaria and insect damage was also observed at this site, but there was not a clear cause of mortality. In northeast Wisconsin, there were scattered reports of maple in Forest, Oneida and Vilas Counties suddenly dying during the growing season. Armillaria was found on some of the dead trees but not on all.

Norway Maple Branch Mortality

Sudden branch mortality, similar to what was noted last year, was observed on a handful of Norway maples in Fond du Lac and Outagamie Counties. As was seen in 2013, severity ranged from one branch to more significant portions of the crown, and mortality was seen on park, street and yard trees. Affected branches wilted suddenly, with leaves turning a rusty red color and remaining on the branch. No insect problems or physical damage were noted on the branches that died in either 2013 or 2014. Samples from 2013 yielded no pathogens, with the exception of one sample that identified *Tubercularia* spp., which has been reported as an asexual stage of *Nectria* spp. Additional samples were submitted for identification in 2014, but results were not available at the time of publication.

Phytoplasma

Phytoplasmas are wall-less, bacteria-like microorganisms that act as pathogens in infected trees, causing small and yellow foliage, slow growth, thin crowns, branch dieback and vertical bark cracks. Infected trees and stumps may produce clusters of spindly shoots that are known as a 'witches broom' because they resemble a broom (Figure 27). The phytoplasma-caused disease on ash is known as ash yellows, and mortality of infected white ash has been observed in forested settings. Phytoplasmas have been detected on ash, black walnut and butternut in Wisconsin using Polymerase Chain Reaction (PCR) testing.

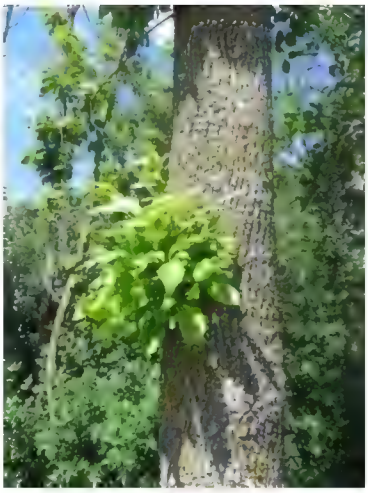

Figure 27. Witches broom on ash, due to phytoplasma infection.

Figure 28. Counties with Phytoplasma detections.

In 2014, Outagamie and Polk Counties had first Phytoplasma confirmations in green and white ash, respectively (Figure 28). Dane County had a first Phytoplasma confirmation from black walnut. A total of 17 samples were submitted for evaluation, including ash, black cherry, black walnut, box elder, elm, ironwood and shagbark hickory. The effect of phytoplasmas on the health of black walnut and butternut in Wisconsin is unknown.

Spring Defoliators

No forest tent caterpillar defoliation was recorded in Wisconsin in 2014. Eastern tent caterpillar populations remained low across most of the state, but building populations were noted on roadside and yard cherry and apple trees in far western Wisconsin.

Two-Lined Chestnut Borer

Two-lined chestnut borer, *Agrilus bilineatus*, continued to be very active in Wisconsin in 2014. Both red and white oak species were impacted in southern Wisconsin, especially on sites with shallow soils (Figure 29). Red oaks that had oak wilt were routinely found to also be infested with two-lined chestnut borer.

In central Wisconsin, continued oak mortality was observed on hills and higher ground with sandy soils. Scattered oak mortality was observed throughout west central Wisconsin. In northwest counties, few observations of two-lined chestnut borer infestation were reported. Armillaria root rot has been frequently associated with two-lined chestnut borer attack when examining mortality.

Figure 29. Two-lined chestnut borer galleries.

Walnut Dieback and Mortality

A number of reports of black walnut dieback and mortality were received from southern Wisconsin, although there were fewer reports than during the drought of 2012. One commonly observed symptom was bark splitting on the upper branches and main trunk (Figure 30), often associated with an elongated, elliptical canker or decay beneath the bark. Ambrosia beetle-like holes were also commonly observed. The observed symptoms suggest possible infestation by the exotic ambrosia beetle, black stem borer (*Xylosandrus germanus*), and Fusarium canker fungi. However, lab tests have not been able to consistently confirm the presence of *Fusarium* spp. in samples.

Figure 30. Typical bark splitting often associated with dieback in walnut in 2014.

It is also possible that the branch and trunk splitting is related to the presence of phytoplasmas in the symptomatic trees. Monitoring for this splitting and testing for phytoplasmas will continue. Cold injury from this past winter may also be playing a role in the observed bark splitting.

Another interesting observation was made on a black walnut tree in Dane County exhibiting numerous bleeding cankers on the trunk and upper limbs. About two-thirds of the upper canopy was dead with a live central crown. When the bark was peeled from the trunk, extensive long cankers and decay patches were evident, much like lines of a zebra (Figure 31). A sample tested by DATCP using PCR techniques was negative for *Phytophthora*, but moist chamber incubation showed sporulating *Fusarium*. *Fusarium* may be a possible cause of these cankers. Samples cultured by the DNR Forest Health lab tested negative for *Geosmithia* and *Botryosphaeria*. In addition, there were some observed orange spore horns fruiting on the inside of the bark. These spore horns were identified as a *Valsa* spp. and might also be related to the canker symptoms.

In addition to lab testing, a large branch was cut up and placed in a rearing container. Three different ambrosia beetle species were recovered. They have not yet been identified but appear to be a *Xylosandrus* species, a *Xyleborinus* species, and many beetles of what are suspected to be a *Monarthrum* species.

Figure 31. Bleeding wounds and large, elongate cankers and decay under the bark of a walnut tree in Dane County.

Conifer Issues

Drought and Conifer Issues

The summer droughts of 2012 and 2013 set the stage for continued problems in conifers across west central Wisconsin in 2014. The species most heavily impacted was red pine, followed by spruce and tamarack. Jack pine, white pine, balsam fir and cedar fared better than the other three species. Damage and/or mortality was caused by pine engraver beetle (Ips), red turpentine beetle, Pityogenes beetle, eastern larch beetle, larch casebearer, spruce bark beetle, Diplodia shoot blight, Rhizosphaera needle cast, Armillaria root rot and Leptographium root rot.

In the central counties there were very few calls during the summer. The pines seemed to be recovering from the 2012 drought with the help of the average summer conditions. In southern Wisconsin, Ips bark beetles were impacting pines on the edges of dying Annosum pockets in Iowa County. In northwest Wisconsin, DNR forest health staff received widespread reports of needle diseases on ornamental spruce, with Rhizosphaera needle cast being particularly prevalent. A contributing factor was a wet and cool spring weather pattern in the northwest.

Eastern Larch Beetle

Eastern larch beetle, *Dendroctonus simplex*, attacks tamarack by boring under the bark. Scattered mortality has been observed across northern Wisconsin during aerial surveys over the past few years, and continued to be noted in 2014 (Figure 32). A 356 acre tamarack stand in northwest Chippewa County suffered moderate amounts of mortality. Scattered tamarack in Oneida and Vilas Counties were killed this year following the stress of being defoliated in the spring by larch casebearer. However, some of these trees were near tamaracks that had been killed by eastern larch beetle in 2013, indicating an expansion of a current infestation. Once eastern larch beetle begins to kill trees in a stand, it seems to slowly continue through the stand even if there are no further obvious stress events.

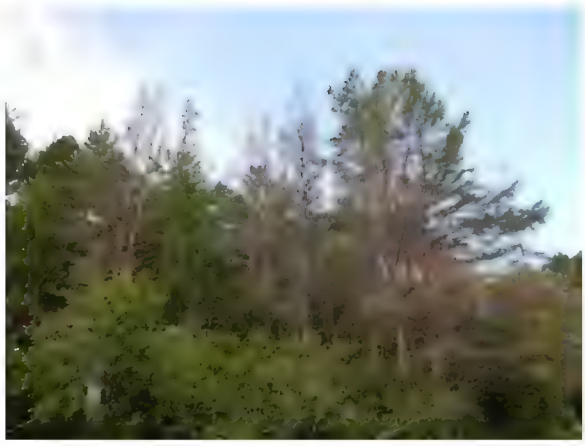

Figure 32. Tamarack mortality from eastern larch beetle following larch casebearer defoliation in the spring.

Jack Pine Budworm

Larval and/or egg mass surveys for jack pine budworm, *Choristoneura pinus*, were conducted in 16 counties where jack pine is common. Few larvae (between 1 and 4) and egg masses (between 1 and 2) per sample plot were found in Bayfield, Burnett, Douglas, Monroe and Washburn Counties. Based on the egg mass survey results, jack pine budworm populations are expected to remain low in 2015.

Larch Casebearer

Widespread defoliation by larch casebearer, *Coleophora laricella*, causes tamarack to have a brownish cast or turn completely brown by late spring, and was easily spotted in many areas of northern Wisconsin this year (Figure 33). More than 8,000 acres of heavy defoliation was mapped in Forest, Iron, Langlade, Lincoln, Oneida, Price and Vilas Counties. Moderate defoliation was observed on 150 acres of tamarack in northwest Chippewa County and southwest Rusk County, and light defoliation was observed in parts of Lincoln and Marinette Counties. Repeated defoliation can weaken the tree, making it more susceptible to mortality from eastern larch beetle infestation.

Figure 33. Severe defoliation on tamarack due to larch casebearer.

Larch casebearer overwinters as a tiny caterpillar and is able to start feeding early as soon as the weather warms up in the spring. They complete their feeding early in the season and pupate on the tree. This year the moths were out in July, at which time they mated and laid eggs. The eggs hatched and the caterpillars began to feed on the foliage of the tamarack that had refoliated, giving the needles a frosted appearance in the fall of 2014.

Spruce Budworm

Nearly 4,000 acres of heavy spruce budworm defoliation on balsam fir and spruce (Figure 34) was aerially mapped in Florence and Marinette Counties. This is the third year of severe defoliation at some of these sites. Additional areas of light to moderate defoliation were noted in Marinette, Portage and Vilas Counties. In Marinette County a number of spruce plantations, some of them young, were severely defoliated.

Figure 34. Severe defoliation by spruce budworm on young spruce plantation.

Regional spruce budworm outbreaks occur every 30-50 years and can last 10-15 years. The last major outbreak in northern Wisconsin lasted for about 10 years, from approximately 1970 to 1980. Balsam fir is the species most heavily damaged by spruce budworm, with repeated defoliation causing top dieback and mortality.

State Nursery Disease Studies

Testing red pine seedlings for asymptomatic infection by *Diplodia pinea*

In the Wisconsin state nurseries, healthy-looking red pines have been tested annually to assess asymptomatic infection by *Diplodia pinea,* the pathogen causing Diplodia shoot blight/collar rot. In 2014, the forest health lab processed 438 asymptomatic seedlings collected from Griffith State Nursery near Wisconsin Rapids. Infection rates were 3.2% for one year-old seedlings, 1.0% for two year-old seedlings, and 5.8% for three year-old red pine seedlings.

Jack pine gall rust surveys at Griffith State Nursery

In the Wisconsin state nurseries, stem and branch galls are occasionally detected on jack pine seedlings at the time of lifting. Annual surveys to evaluate the incidence of gall rusts on jack pine seedlings at the time of lifting were initiated in 2008. At the time of lifting in mid-April of this year, 1,000 one year-old seedlings and 1,000 two year-old seedlings were visually examined for the presence of galls at Griffith State Nursery. Gall formation was visible on 2.4% of one year-old seedlings and 0.6% of two year-old seedlings.

In addition to the assessment of gall incidence at the time of lifting, asymptomatic seedlings with no visible galls or swelling were randomly collected from the lifted stock and potted in late April 2014. One hundred one year-old seedlings and 100 two year-old seedlings were planted in plastic pots and placed in the greenhouse to limit additional inoculum exposure. In October, gall formation was visible on 10% of one year-old seedlings and none of the two year-old seedlings.

Jack pine gall rust – pathogen identification study

Sixty-four galled jack pine seedlings that were potted in previous years were examined for gall rust sporulation in the spring of 2014, to determine whether the seedlings had eastern gall rust or western gall rust. Sixteen of the 64 seedlings had sporulation, including five seedlings that had not sporulated before. Examination of fungal germ tube lengths indicated that all seedlings were infected with *Cronartium quercuum*, the pathogen causing eastern gall rust.

Forty-six of the 64 galled jack pine seedlings had sporulated during the four years of this study. Of these, 37 were from Griffith State Nursery, 5 were from Wilson State Nursery and 4 were from Hayward State Nursery. All tested seedlings were determined to be infected with the pathogen causing eastern gall rust.

White pine blister rust survey at Wilson State Nursery

A survey to evaluate the incidence of white pine blister rust at Wilson State Nursery (near Boscobel) was conducted in 2014. In mid-April, 1,000 three year-old white pine seedlings were randomly dug from nursery beds. Each seedling was thoroughly examined for the presence of cankers and/or aecial blisters. One hundred seedlings were randomly collected from the lifted stock and potted in May for examination throughout the growing season. No signs of white pine blister rust (cankers or blisters) were observed.

In addition, an examination of seedlings that were potted in 2013 did not find any blister rust cankers or blisters. However, stem cankers and aecial blisters were detected on three year-old white pine seedlings in 2012. Based on the two-year study (2013-14), it was concluded that the incidence of white pine blister rust at Wilson State Nursery was very low to rare.

Abiotic Issues

Storm Damage

Wisconsin experienced a number of tornados and wind storms in 2014, with reports gathered from various sources including DNR foresters, city managers and county Emergency Management Departments. Events contributed to this annual report were:

- In Grant County, a seven mile path of damage to agricultural and forest land in the Towns of Fennimore and Wingville. In addition, the City and Town of Platteville experienced extensive damage to structures, urban trees, forests and agricultural land along a 3 mile path.
- In Green County, widely scattered damage was reported along a 10 mile stretch in Clarno, Jefferson, Decatur and Spring Grove Townships. In addition, a 5 mile stretch of damage was recorded in northwest Green County in the Town of York, extending into the Town of Perry in southwest Dane County.
- In Iowa County, a 25 mile-long area of damage impacted portions of the Towns of Eden, Highland, Dodgeville, Ridgeway and Arena. In addition, a 9 mile-long area of damage impacted agricultural and forest lands in the Towns of Linden and Dodgeville. Two areas north of the City of Dodgeville also experienced significant damage.
- In Lafayette County, a 6 mile stretch of agricultural and forest lands in Towns of Belmont and Kendall received damage.
- In Sawyer County, a severe wind storm occurred in early September, creating scattered pockets of wind-throw damage on about 10,000 acres of northern hardwood forest.
- Storm damage was also reported in the Verona area of Dane County as well as around Mirror Lake and Devils Lake State Parks in Sauk County.

2014 Weather Conditions

This year started with an extremely cold winter and temperatures remained at or below normal for most of the year (Figure 35). Precipitation was average or above average for most of the year across much of the state. According to the University of Nebraska - Lincoln drought monitor, none of Wisconsin was abnormally dry at the end of 2014. This is in contrast to the start of 2014, when approximately 40% of Wisconsin was in some type of dry or drought condition (mostly in western counties).

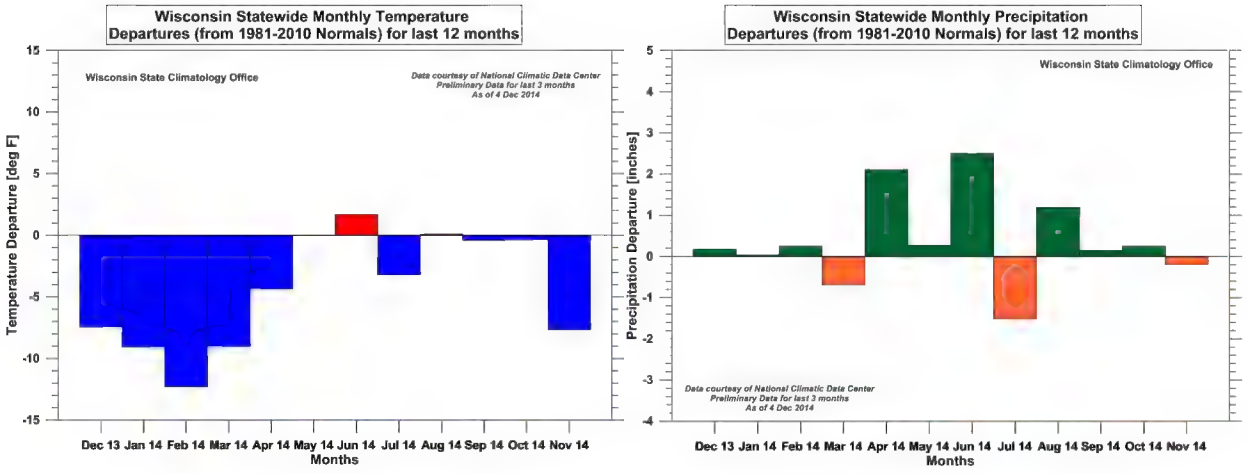
Wisconsin Statewide Monthly Temperature
Departures (from 1981-2010 Normals) for last 12 months
Wisconsin State Climatology Office
Data courtesy of National Climatic Data Center
Preliminary Data for last 3 months
As of 4 Dec 2014
Temperature Departure [deg F]
15
10
5
0
-5
-10
-15
Dec 13 Jan 14 Feb 14 Mar 14 Apr 14 May 14 Jun 14 Jul 14 Aug 14 Sep 14 Oct 14 Nov 14
Months
Wisconsin Statewide Monthly Precipitation
Departures (from 1981-2010 Normals) for last 12 months
Wisconsin State Climatology Office
Data courtesy of National Climatic Data Center
Preliminary Data for last 3 months
As of 4 Dec 2014
Precipitation Departure [inches]
5
4
3
2
1
0
-1
-2
-3
-4
Dec 13 Jan 14 Feb 14 Mar 14 Apr 14 May 14 Jun 14 Jul 14 Aug 14 Sep 14 Oct 14 Nov 14
Months

Figure 35. Statewide monthly temperature (°F) and precipitation (inches) departure from normal for 2014. Source: Wisconsin State Climatology Office.

Winter Damage to Conifers

Winter injury to conifers, including needle desiccation and salt damage along roads, was significant in many areas of the state following the long, cold winter of 2013-14. Symptoms began appearing in late winter but became more evident in spring and early summer. In southern Wisconsin, winter damage was common, especially on northern white cedar. In western Wisconsin, winter damage was widespread on pines, spruce, balsam fir and cedars. In the north and northeast, hemlock was heavily impacted by the long cold winter. Hemlocks that were not near roads lost up to 50% of their needles due to the winter impacts. Hemlocks along roads were even more severely impacted, as were spruce, balsam fir, pines and cedars that were exposed to any salt spray.

Figure 36. Winter injury on hemlock.

Balsam fir of all size classes suffered twig tip mortality (2-3 inches long) scattered throughout the crown, although it appeared to be more concentrated in the lower two-thirds of the crown (Figure 36). These dead twig tips and attached needles remained on the trees throughout the growing season.

Figure 37. *Rhizosphaera* needle cast on spruce.

Rhizosphaera needle cast symptoms (Figure 37) were severe on spruce following the winter, with older needles turning brown very early in the spring at the same time as winter injury symptoms were appearing. In some trees, entire branches lost all of their needles due to the combination of Rhizosphaera needle cast and winter injury.

Minor Issues Table

Tree Genus or Category	Cause of Damage	Species Affected	Type of Damage	Location Where Damage Was Observed
Abiotic Injury	Frost damage	Aspen, northern pin oak, red oak, spruce, fir, white cedar	Bud and shoot mortality, leaf/needle damage	Barron, Burnett, Douglas, Polk, Rusk, Sawyer and Washburn Counties
	Hail damage	Red and white pine	Severe shoot damage	Sawyer County
	Herbicide damage	White oak	Deformed leaves	Iowa County
	Tatters	White oak	Deformed leaves	Dane and Green Counties
Alder	Fall webworm (*Hyphantria cunea*)	Alder	Defoliation	Burnett, Polk and Washburn Counties; common in north central Wisconsin
Ash	Ash bark beetle (*Hylesinus spp.*)	Ash	Mortality	Grant and Rock Counties
	Ash leaf drop (frost or Anthracnose)	Ash	Leaf drop	Outagamie and Waupaca Counties; common in southern Wisconsin
	Armillaria root rot (pathogen: *Armillaria mellea*)	Ash	Dieback and mortality	Richland and Taylor Counties
	Clearwing ash borer (*Podosesia syringae*)	Ash	Mortality	Taylor County
	Ash flower gall mite (*Aceria fraxiniflora*)	Ash	Deformed flowers	Fond du Lac, Outagamie and Winnebago Counties; scattered in west central counties
	Red-headed ash borer (*Neoclytus acuminatus*)	Ash	Mortality	Dane and Marinette Counties

Tree Genus or Category	Cause of Damage	Species Affected	Type of Damage	Location Where Damage Was Observed
Ash (continued)	Perenniporia stem rot (pathogen: *Perenniporia fraxinophila*)	Ash	Heartwood decay	Lafayette County
Aspen	Blotchminer (*Phyllonorycter* spp.)	Aspen	Leaf mining, crown discoloration	Florence, Forest, Marinette, Oconto, Oneida and Vilas Counties
	Marssonina leaf spot (pathogen: *Marssonina* spp.)	Aspen	Defoliation, premature leaf drop	Chippewa, Dunn, Eau Claire, Jackson and St. Croix Counties
	Large aspen tortrix (*Choristoneura conflictana*)	Aspen	Defoliation	Marinette County
Balsam Fir	Balsam fir needle rust (several pathogens)	Balsam fir	Needle discoloration and loss	Florence, Forest, Oneida and Vilas Counties
Basswood	Nectria canker (pathogen: *Nectria galligena*)	Basswood	Cankers	Oconto and Shawano Counties
Cherry	Eastern tent caterpillar (*Malacosoma americanum*)	Cherry	Defoliation	Burnett, Rusk and Washburn Counties; scattered in southern and west central counties; light in northeast Wisconsin
	Fall webworm (*Hyphantria cunea*)	Cherry	Defoliation	Burnett, Polk and Washburn Counties
Elm	Dutch elm disease (pathogen: *Ophiostoma* spp.)	Elm	Mortality	Dane and Sauk Counties; scattered in west central, northeast and north central Wisconsin
	Elm bark beetle (*Hylurgopinus rufipes*)	Elm	Mortality	Sauk County
	European elm bark beetle (*Scolytus multistriatus*)	Elm	Mortality	Green and Rock Counties

Tree Genus or Category	Cause of Damage	Species Affected	Type of Damage	Location Where Damage Was Observed
Hickory	Hickory bark beetle (*Scolytus quadrispinosus*)	Hickory	Crown dieback and tree mortality	Clark, Dane, Marinette, Pierce, Portage, Shawano and Wood Counties
	Hickory decline (pathogen: *Ceratocystis smalleyii*)	Hickory	Bleeding cankers, crown dieback and tree mortality	Clark, Dane, Marinette, Portage, Shawano and Wood Counties
	Phomopsis gall (pathogen: *Phomopsis* spp.)	Hickory	Branch galls and dieback	Dane, Oconto and Shawano Counties
	Fall webworm (*Hyphantria cunea*)	Bitternut hickory	Light defoliation	Burnett and Polk Counties
Linden	Japanese beetle (*Popillia japonica*)	Linden	Defoliation	Brown, Dane and Oconto Counties
Maple	Fusarium canker (pathogen: *Fusarium* spp.)	Red maple	Branch dieback	Dane and Sauk Counties
	Botryosphaeria canker (pathogen: *Botryosphaeria* spp.)	Red maple	Branch dieback	Dane and Sauk Counties
	Giant tar spot (pathogen: *Rhytisma acerinum*)	Norway maple	Leaf damage	Brown, Dane and Oconto Counties
	Columbian timber beetle (*Corthylus columbianus*)	Silver maple	Stem infestation and staining	Calumet, Kewaunee and Manitowoc Counties
	Phomopsis canker (pathogen: *Phomopsis spp.*)	Red and sugar maple	Stem cankers	Dane and Sauk Counties
Miscellaneous Biotic Injury	Armillaria root rot (pathogen: *Armillaria mellea*)	Conifers and hardwoods	Tree decline and mortality	Burnett and Washburn Counties; scattered in west central counties; common in southern Wisconsin

Tree Genus or Category	Cause of Damage	Species Affected	Type of Damage	Location Where Damage Was Observed
Miscellaneous Biotic Injury (continued)	Fall webworm (*Hyphantria cunea*)	Hardwoods	Defoliation	Scattered in southern and west central counties; heavy in north central Wisconsin
	Heavy seed production	Various hardwood and conifer species		White pine throughout northwest Wisconsin; scattered in southern and west central counties
Oak	Armillaria mycoparasite (*Entoloma abortivum*)	Red oak	Honey mushroom parasitism	Common in southern Wisconsin
	Bacterial wetwood/slime flux	Red oak, white oak	Tree decline, with two-lined chestnut borer present	Washburn County
	Botryosphaeria canker (pathogen: *Botryosphaeria dothidea*)	Northern pin, red and white oak	Branch tip death	Burnett, Vilas and Washburn Counties
	Bur oak blight (pathogen: *Tubakia iowensis*)	Bur oak	Early leaf browning	First detection in Marquette County
	Cynipid wasp (unknown spp.) and woodpecker feeding	Bur oak	Girdling of trees by woodpeckers attacking larvae	Green, Milwaukee and Outagamie Counties
	Eastern gall rust (pathogen: *Cronartium quercuum*)	Oak	Leaf spots	Scattered in west central counties
	Kermes scale (*Kermes* spp.)	Oak	Twig dieback	Marinette, Oneida and Vilas Counties
	Jumping oak gall (*Neuroterus* spp.)	White oak	Deformed leaves	Richland County

Tree Genus or Category	Cause of Damage	Species Affected	Type of Damage	Location Where Damage Was Observed
Oak (continued)	Oak slug sawfly (*Caliroa quercuscoccinae*)	Oak	Window paning and leaf skeletonizing	Richland County
	Oak twig pruner (*Anelaphus villosus*)	Northern red oak	Branch mortality	Shawano County
	Oak wilt (pathogen: *Ceratocystis fagacearum*)	Red oak	Mortality	Scattered in west central counties
	Phomopsis canker (pathogen: *Phomopsis* spp.)	White oak	Sapling mortality	Richland County
	Oak skeletonizer (*Bucculatrix ainsliella*)	White oak	Defoliation	Marinette County
	Two-lined chestnut borer (*Agrilus bilineatus*)	Oak	Girdling and tree mortality	Burnett County and scattered in west central counties; common in southern counties
Pine	Armillaria root disease (pathogen: *Armillaria* spp.)	White pine	Sapling mortality	Shawano and Waupaca Counties
	Diplodia shoot blight (pathogen: *Diplodia pinea*)	Jack and red pine	New shoot death with shepherd's crook and/or branch mortality	Sauk County; scattered in west central counties
	Eastern pine gall rust (pathogen: *Cronartium quercuum*)	Jack pine	Branch and stem galls	Scattered in west central counties
	Ips bark beetles (*Ips* spp.)	Red pine	Tree mortality	Burnett, Douglas, Iowa, Sauk and Washburn Counties; scattered in west central counties

Tree Genus or Category	Cause of Damage	Species Affected	Type of Damage	Location Where Damage Was Observed
Pine (continued)	Leptographium root rot (pathogen: *Leptographium* spp.)	Red and white pine	Tree decline and mortality	Grant, Iowa, Richland and Sauk Counties
	Pityogenes beetle (*Pityogenes hopkinsi*)	White pine	Mortality of trees 4 to 6 inches in diameter	Scattered in southern and west central counties
	Pityophthorus beetle (*Pityophthorus puberulus*)	Red Pine	Branch mortality	Sauk County
	Redheaded pine sawfly (*Neodiprion lecontei*)	Red pine	Defoliation	Vilas County
	Red pine pocket mortality (complex of Leptographium root disease and various insects)	Red pine	Tree decline leading to mortality	Burnett and Monroe Counties
	Red turpentine beetle (*Dendroctonus valens*)	Red pine	Stem infestation and possible tree mortality	Iowa and Washburn Counties; scattered in west central counties
	White pine blister rust (pathogen: *Cronartium ribicola*)	White pine	Trunk and branch cankers, tree and branch mortality	Washburn County
	White pine weevil (*Pissodes strobi*)	Jack, Scotch and white pine	Terminal leader mortality on open-grown saplings	Ashland County
Spruce	Diplodia shoot blight (pathogen: *Diplodia pinea*)	Colorado blue spruce	New shoot mortality	St. Croix County
	Spruce bark beetle (*Ips typographus*)	Spruce	Mortality	St. Croix County

Tree Genus or Category	Cause of Damage	Species Affected	Type of Damage	Location Where Damage Was Observed
Spruce (continued)	Spruce spider mite (*Oligonychus ununguis*)	Colorado blue spruce	Needle discoloration	St. Croix County
	Rhizosphaera needlecast (pathogen: *Rhizosphaera kalkhoffii*)	Colorado blue and white spruce	Needle discoloration and loss	Barron, Burnett, Douglas, Polk, Richland, Rusk, Sawyer and Washburn, Counties; scattered in west central, northeast and north central counties
	Spruce needle rust (pathogen: (*Chrysomyxa* spp.)	Black and white spruce	Needle discoloration and loss	Forest, Oneida and Vilas Counties
Tamarack	Spruce spider mite (*Oligonychus ununguis*)	Tamarack	Needle discoloration	Florence, Forest, Marinette Oconto, Oneida and Vilas Counties
Walnut	Botryosphaeria canker *(*pathogen: *Botryosphaeria* spp.*)*	Black walnut	Branch cankers	Iowa County
	Fusarium canker (pathogen: *Fusarium spp.*)	Black walnut	Stem cankers	Dane County
Willow	Willow flea weevil (*Rhynchaenus rufipes*)	Willow	Defoliation	Brown, Calumet, Marinette, Oconto and Shawano Counties

Notes:

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- The USDA is an equal opportunity provider and employer.